3.12

$\vec{E} = \hat{x}xy - \hat{y}(x^2 + 2y^2)$

$a)\ \oint \vec{E}.d\vec{l}$

$$= \int_{x=0}^{1} xydx - \int_{0}^{1}(x^2 + 2y^2)dy + [\int xydx - \int (x^2 + 2y^2)dy]$$

$$= -1$$

$$b)\nabla \times \vec{E} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xy & -(x^2 + 2y^2) & 0 \end{vmatrix} = -3x\hat{z}$$

$$\int \nabla \times \vec{E}.d\vec{s} = \int_{x=0}^{1} \int_{y=o}^{x} -3xdxdy = -1$$